WP-GHG-2: CO_2 estimates from satellite instruments: status of IASI case
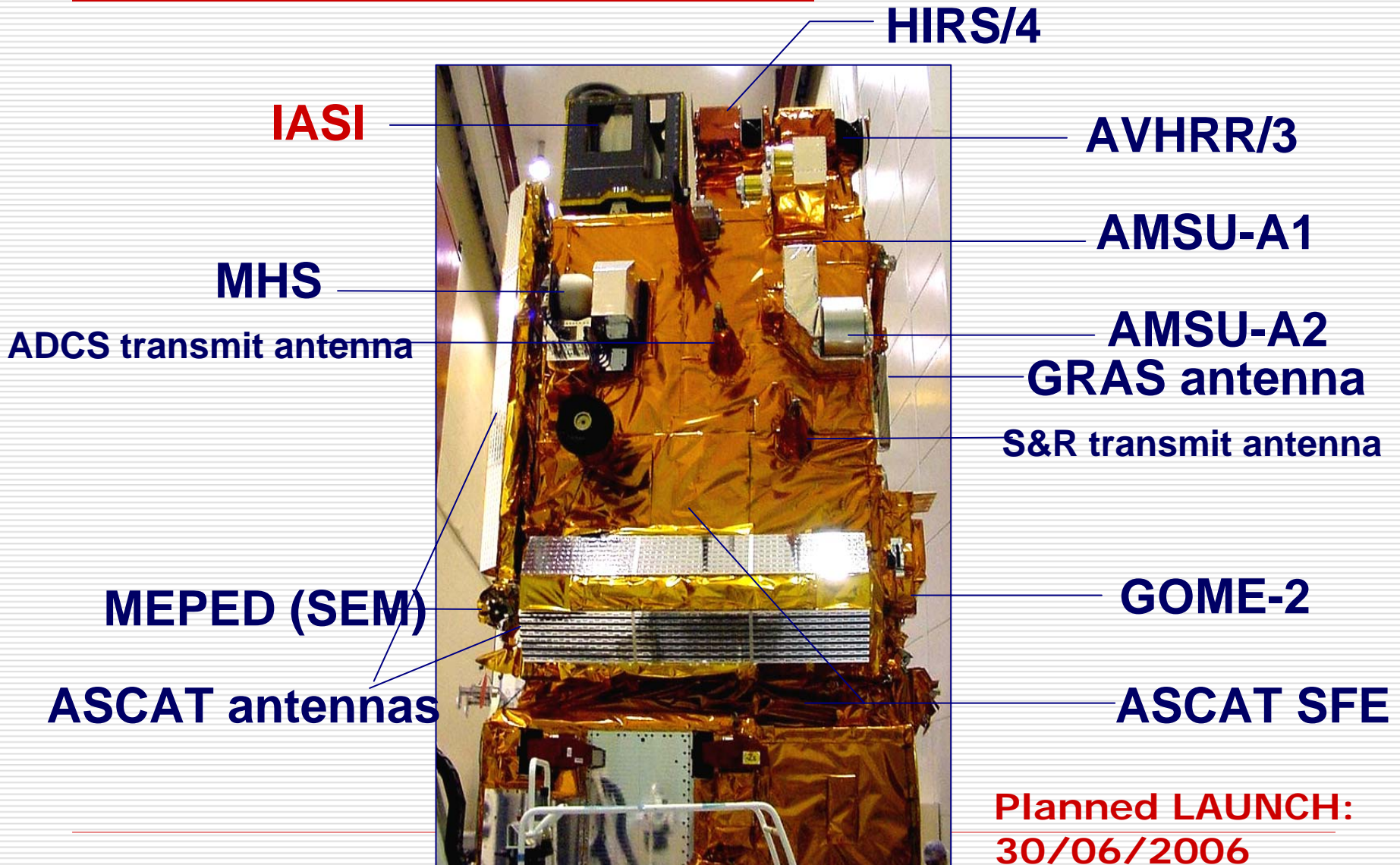
Gaëlle Dufour, Alain Chédin, Noëlle Scott, Raymond Armante

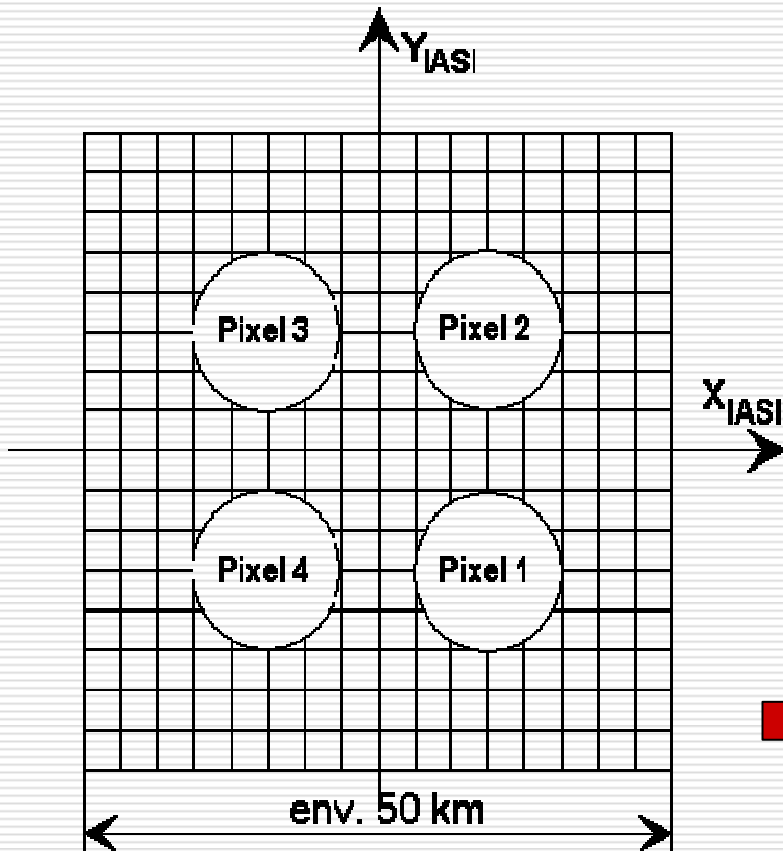Laboratoire de Météorologie Dynamique – CNRS/IPSL

Metop Instrument Accommodation

HIRS/4

IASI

AVHRR/3

AMSU-A1

MHS

AMSU-A2

ADCS transmit antenna

GRAS antenna

S&R transmit antenna

MEPED (SEM)

GOME-2

ASCAT antennas

ASCAT SFE

Planned LAUNCH: 30/06/2006

Fields of view

- Pixel size : 12 km (nadir)
- Imager : 64 x 64 pixels

→ The noise can be divided by 2

Channel selection method

- ☐ Forward model 4A → TIGR database for a set of 829 tropical atmospheres

- ☐ Mean tropical atmosphere

- ☐ Forward model 4A
  - ■ Spectra + Jacobians

- ☐ Sensitivity study of each IASI channel
  - ■ Using integrated Jacobians
  - ■ Filters to eliminate channels contaminated by other trace gases or having too strong stratospheric contribution

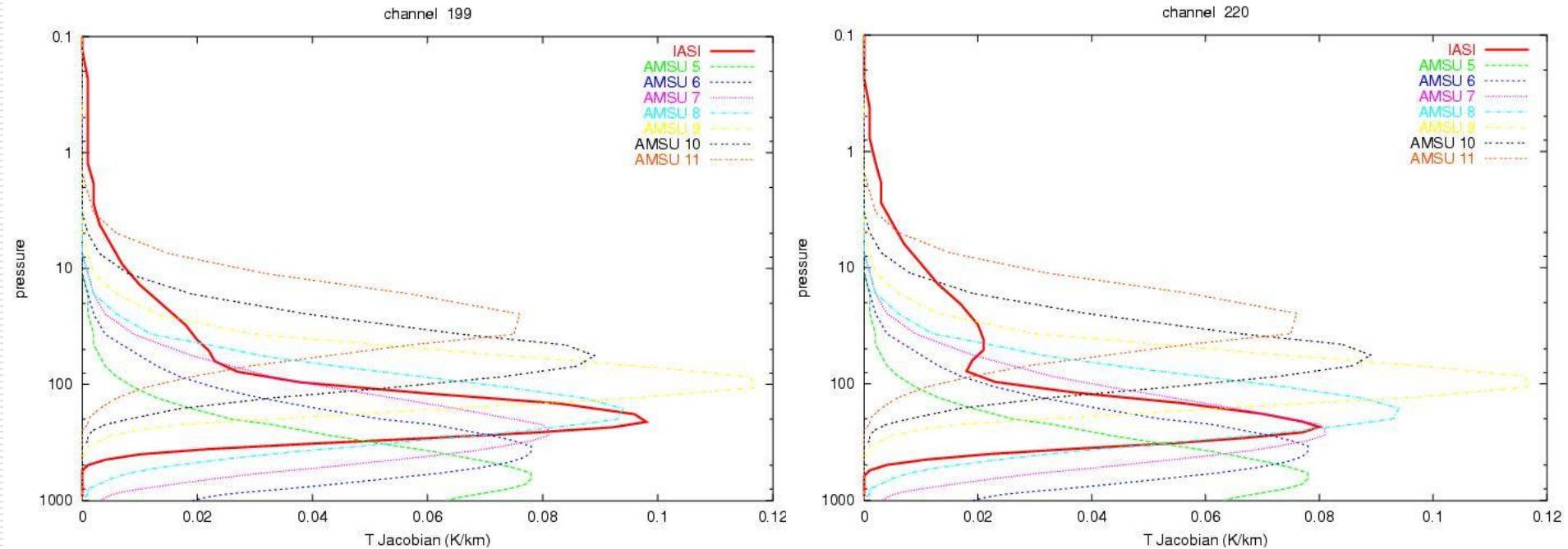# IASI CO$_2$ Channels: first selection

□ Thresholds:

- CO$_2$ > 0.1 K for a perturbation of 1%
- H$_2$O and O$_3$ < 0.05 K for a perturbation of 20%

□ 24 channels selected

Chan. Nb.	cm^{-1}	CO$_2$ (K)	Chan. Nb.	cm^{-1}	CO$_2$ (K)	Chan. Nb.	cm^{-1}	CO$_2$ (K)
198	694.25	0.110	220	699.75	0.108	232	702.75	0.141
199	694.50	0.125	112	700.50	0.108	233	703.00	0.127
205	696.00	0.133	224	700.75	0.131	238	704.25	0.127
206	696.25	0.119	225	701.00	0.139	240	704.75	0.116
211	697.50	0.129	226	701.25	0.139	247	706.50	0.108
217	699.00	0.115	229	702.00	0.109	254	708.25	0.116
218	699.25	0.141	230	702.25	0.133	298	719.25	0.104
219	699.50	0.138	231	702.50	0.131	305	721.00	0.113

Comparison T Jacobians AMSU/IASI

Selection according to the channel sensitivity to the stratospheric temperature

New selection criteria – new channel list

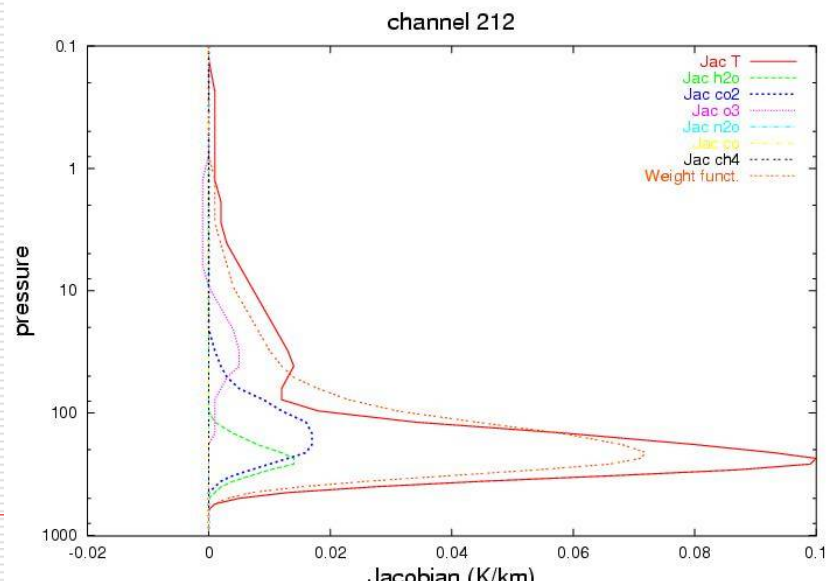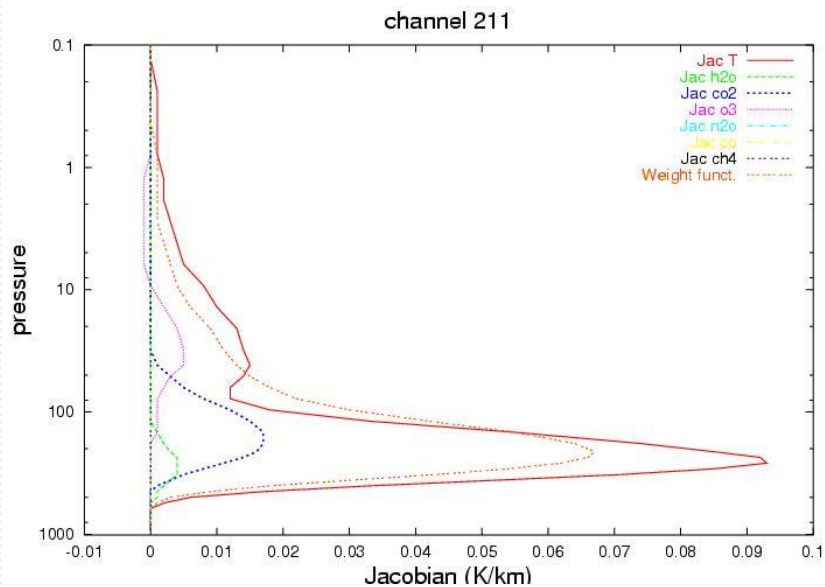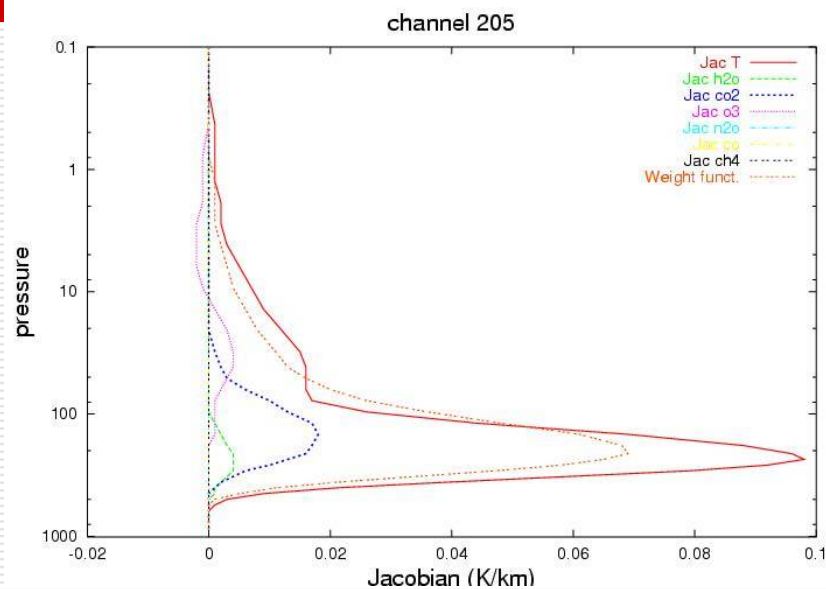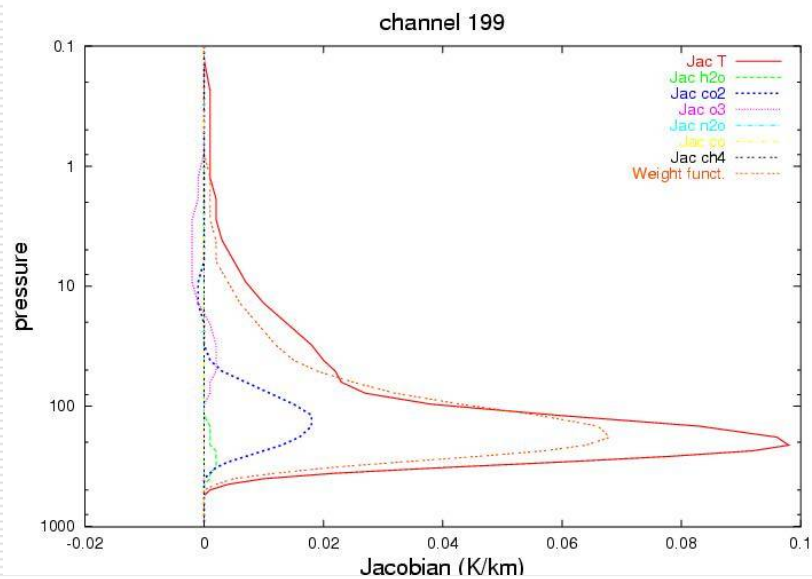- ☐ Thresholds:
  - ■ $CO_2 > 0.1$ K for a perturbation of 1%
  - ■ **$H_2O < 0.065$ K for a perturbation of 20% - relaxed**
  - ■ $O_2 < 0.05$ K for a perturbation of 20%
  - ■ **$T_{strato} < 0.05$ K for a perturbation of 1K**
- ☐ 14 channels selected

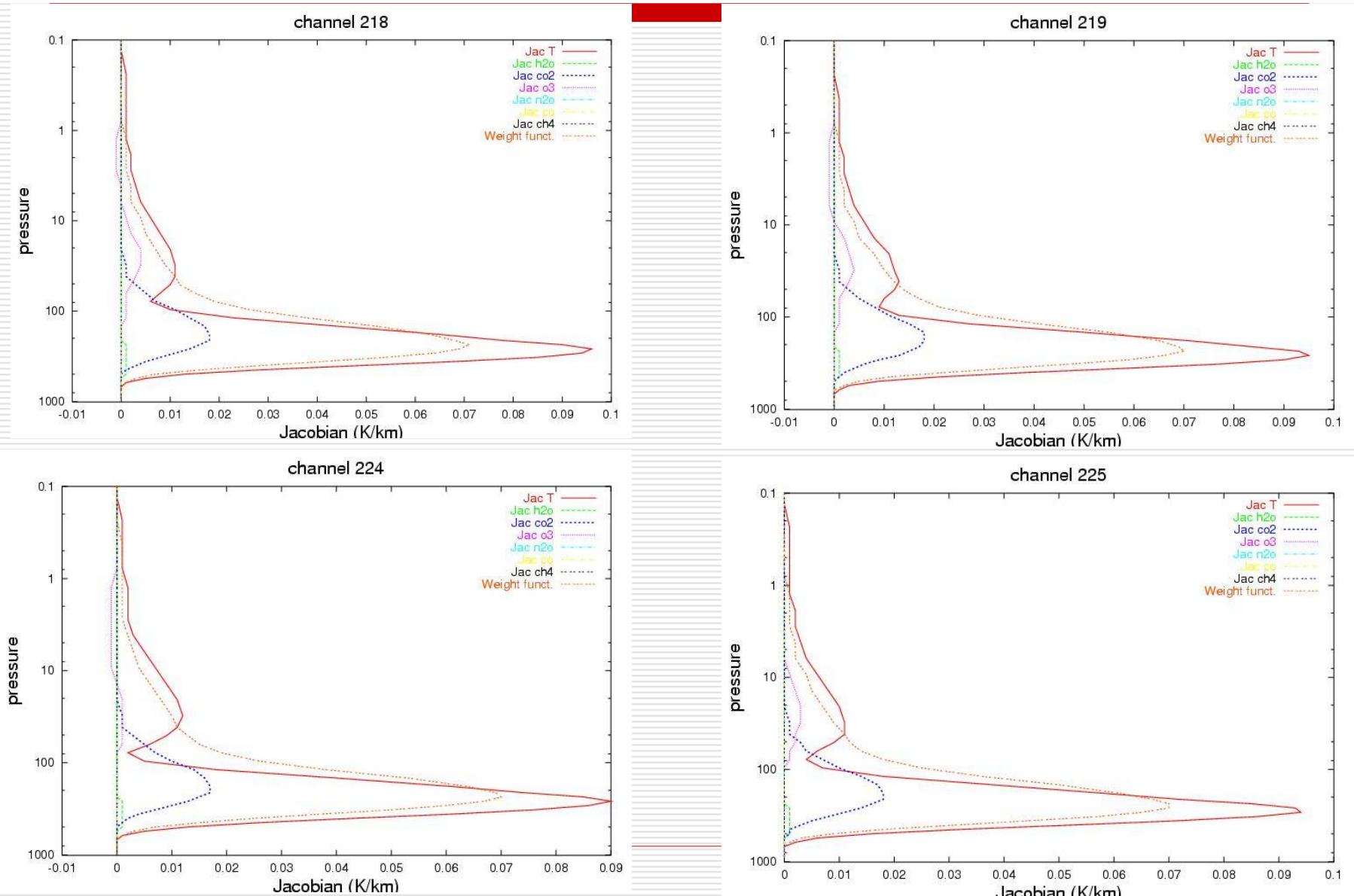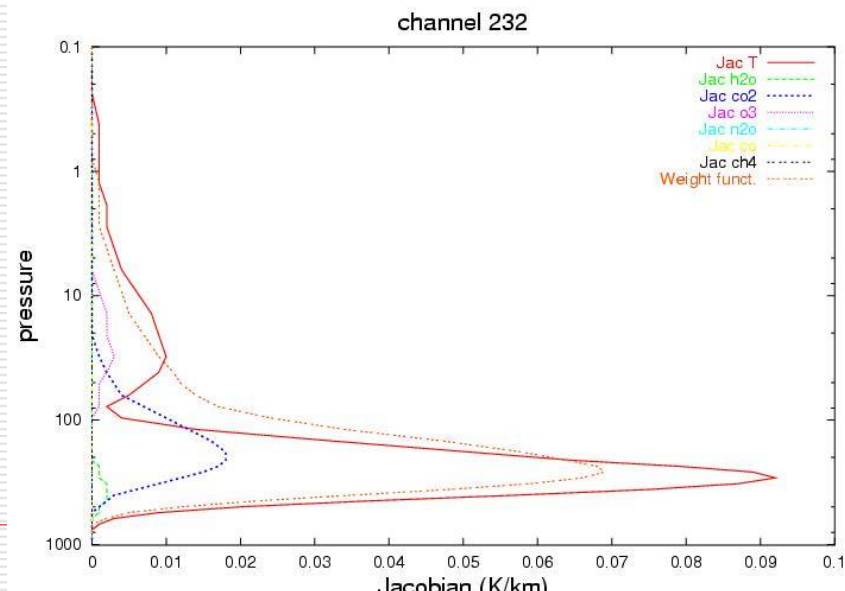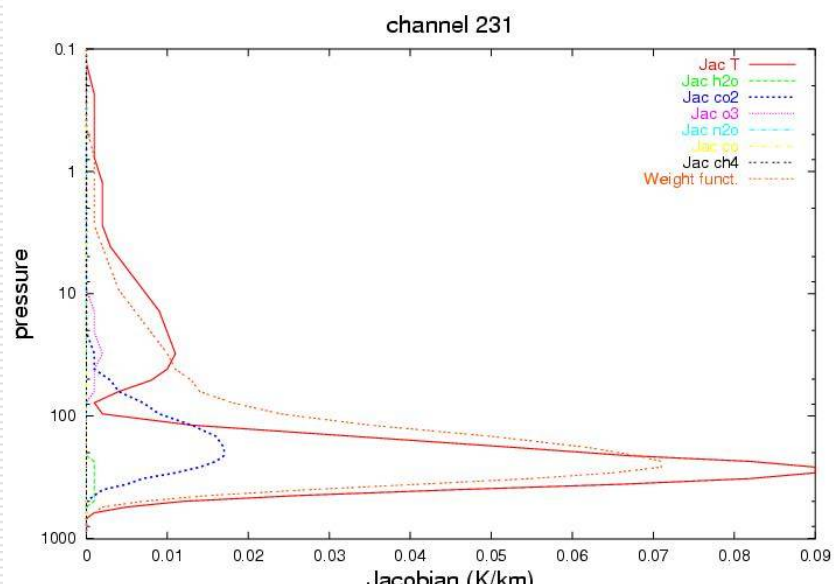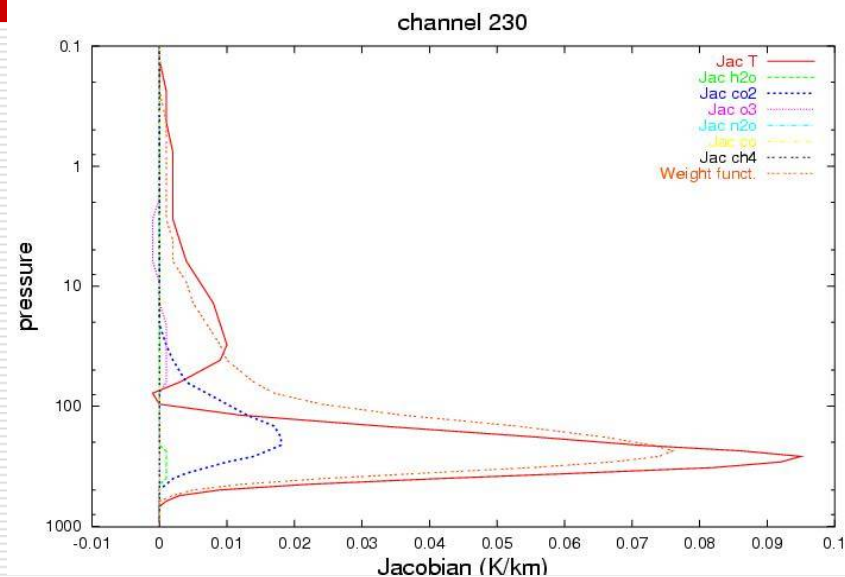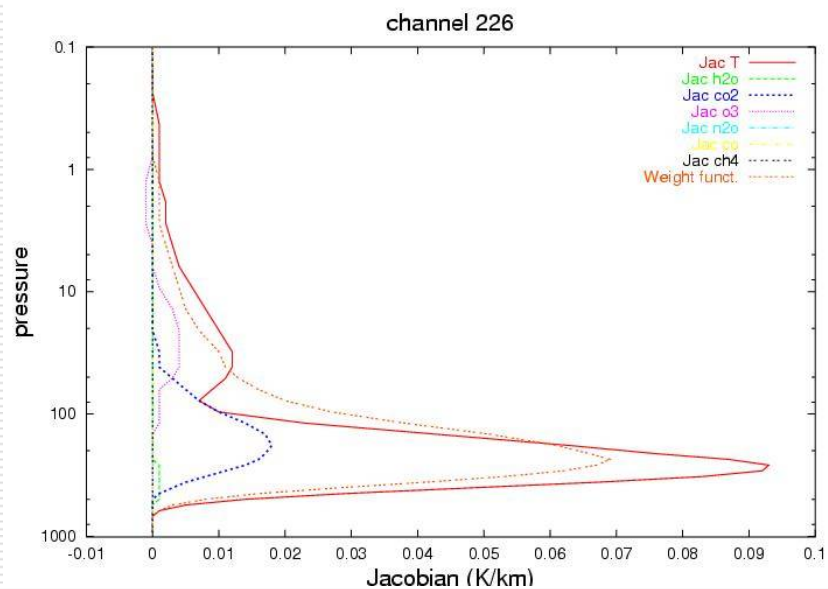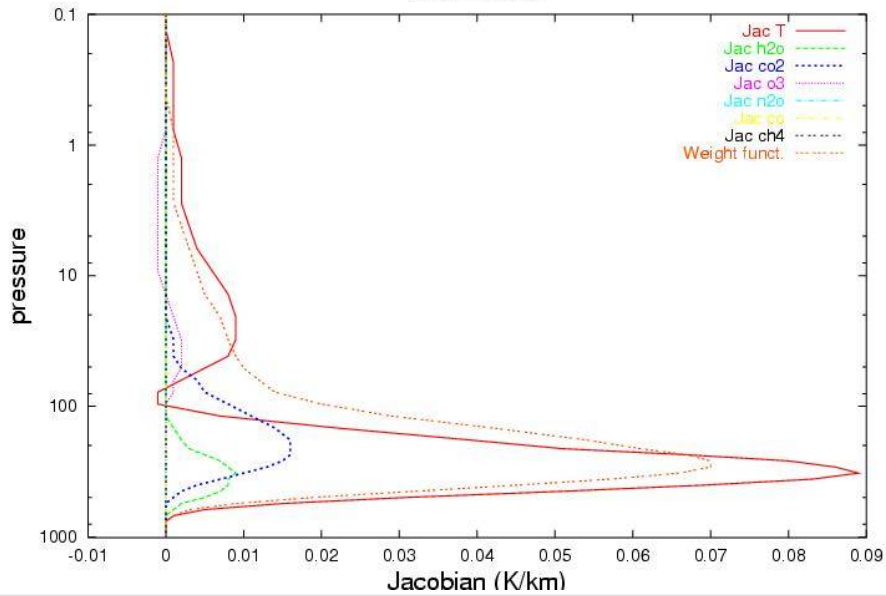| Chan. Nb.	cm^{-1}	CO_2 (K)	Chan. Nb.	cm^{-1}	CO_2 (K)
199	694.50	0.125	225	701.00	0.139
205	696.00	0.133	226	701.25	0.139
211	697.50	0.129	230	702.25	0.133
212	697.75	0.130	231	702.50	0.131
218	699.25	0.141	232	702.75	0.141
219	699.50	0.138	**237**	704.00	0.130
224	700.75	0.131	238	704.25	0.127

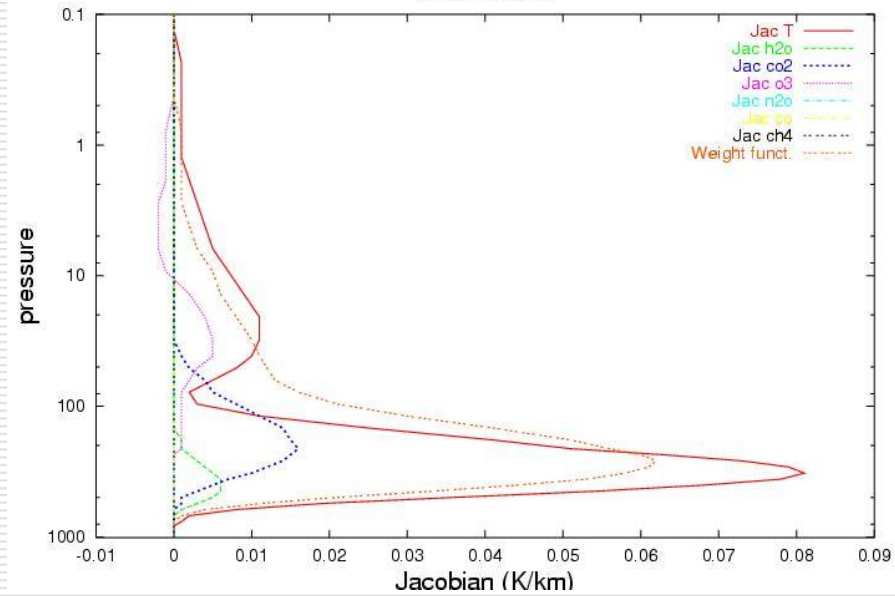# Jacobians for different variables

Jacobians for different variables

Jacobians for different variables

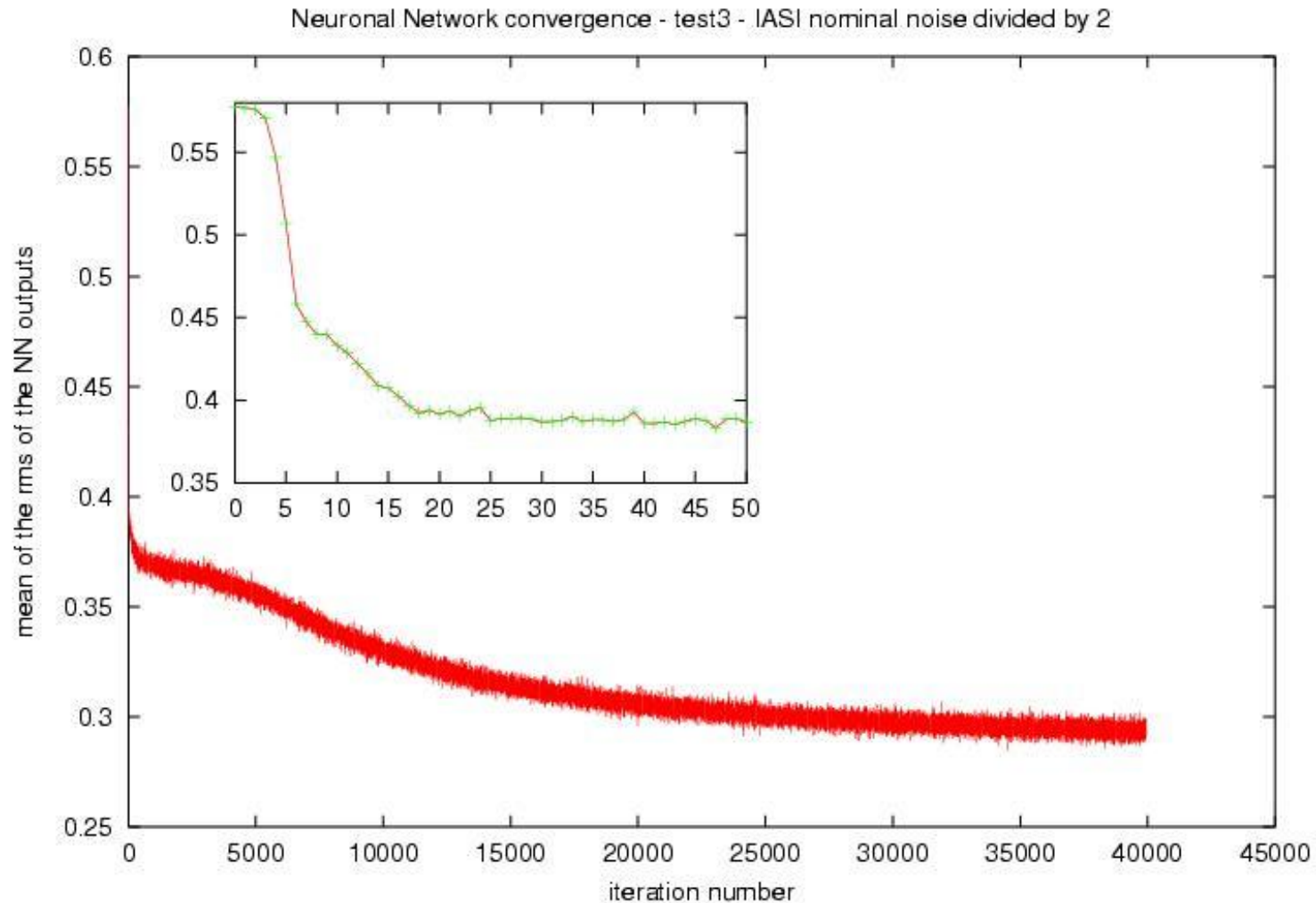# Jacobians for different variables

Simulations of CO_2 estimates from IASI

- ☐ Neuronal network
- ☐ Decorrelation of T and CO_2 variations thanks to AMSU temperature
- ☐ Inputs
  - ■ 14 IASI channels, 5 AMSU channels, 4 differences (AMSU-IASI)
- ☐ Outputs
  - ■ CO_2 vmr (for a constant tropospheric column)

- ☐ Learning phase with noisy inputs
- ☐ Work in progress

First convergence tests: IASI nominal noise and 4 FOVs

Neuronal Network convergence - test3 - IASI nominal noise divided by 2

WP-GHG-7: CH$_4$ channel selection: IASI case

First CH_4 channel list

- ☐ Thresholds:
  - ■ CH_4 > 0.4 K for a perturbation of 4%
  - ■ H_2O < 0.17 K for a perturbation of 20%
  - ■ N_2O < 0.06K for a perturbation of 1%
- ☐ 8 channels selected

Chan. Nb.	cm^{-1}	CH_4 (K)	Chan. Nb.	cm^{-1}	CH_4 (K)
2634	1303.25	0.531	2639	1304.50	0.619
2635	1303.50	0.599	2640	1304.75	0.554
2636	1303.75	0.576	2641	1305.00	0.584
2637	1304.00	0.574	2642	1305.25	0.552

Jacobians for different variables

The best channel for H_2O and T_{strato}

The worst channel for H_2O

The worst channel for T_{strato}